



# ***Engineering Analysis Background***

- **Interoperable suite of Engineering Analysis (EA) APs/Modules**
  - **Material Services Information (Material properties & allowables)**
  - **AP209 (DIS document currently in development) will be part of EA suite**
  - **More APs/Modules may be identified later**
- **APs/Modules will rest on an integrated EA Core Model (Part 107) foundation**



# AP209: Composite & Metallic Analysis & Related Design

## Analysis Discipline Product Definitions

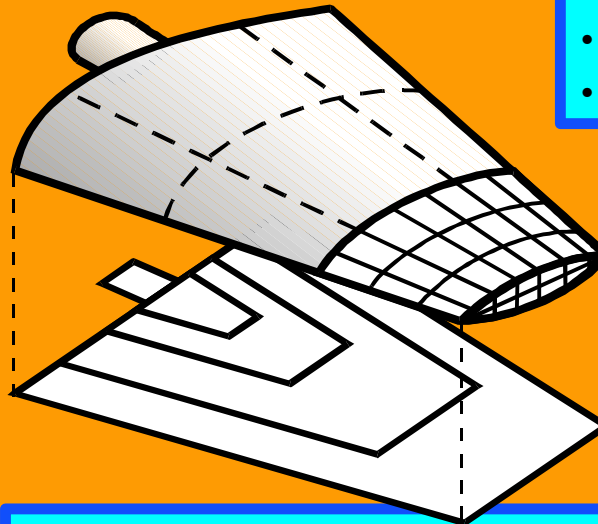
- Finite Element Analysis
  - Model (Nodes, Elements, Properties,...)
  - Controls (Loads, Boundary Constraints,...)
  - Results (Displacements, Stresses,...)
- Analysis Report

## Design Discipline Product Definition

- Shape Representations
- Assemblies

## Configuration Control, Approvals

- Part, product definitions
- Finite element analysis model, controls, and results



## Information Shared Between Analysis & Design

- 3D Shape Representations
- Composite Constituents
- Material Specifications & Properties
- Part Definitions

## Composite Constituents

- Ply Boundaries, Surfaces
- Laminate Stacking Tables
- Reinforcement Orientation

## Material Specifications & Properties

- Composites
- Homogeneous (metallics)

## • 3D Shape Representation

### • AP202/203 Commonality Plus Composite Specific 3D Shapes

- Advanced B-Representation
- Facetted B-Representation
- Manifold Surfaces With Topology
- Wireframe & Surface without Topology
- Wireframe Geometry with Topology
- Composite Constituent Shape Representation



# ***Engineering Analysis Accomplishments Since the Last Offsite***

- **AP209 (Composite and metallic structural analysis and related design)**
  - **DIS document updated based on Qualification Review**
  - **Finalized AP209 Concept of Operations document**
- **Conducted TAC demonstration and workshop; defined scenario for Fall '99 demonstration**
- **Conducted harmonization/modularization workshop with Engineering Analysis core Model (EACM)**



# ***Engineering Analysis Plans for the Next Quarter***

- AP209
  - Deliver and promote DIS of Parts 104 and 209 to ensure successful ballots
  - Continue defining Proof of Concept demo for next TAC
- Continue modularization and harmonization of AP209 and EACM
  - EACM expert participating in Offsite
- Distribute AP209 coverage analysis



# ***Engineering Analysis Challenges***

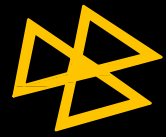
- Harmonization of Engineering Analysis Core Model (EACM) with existing STEP APs
  - Significant semantic integration issues due to differences in modeling style
    - Use module architecture as basis for integration
- Gaining vendor support for AP209
  - Continue to foster encouragement from industrial users through demonstrations
  - Promote to NAFEMS to reach larger audience
  - Improving translator quality
    - Distributed Recommended Practices document and expand test data through prove-out activities



# ***Engineering Analysis Challenges (Cont'd)***

- Breadth of requirements
  - Distribute AP209 coverage analysis; work with NAFEMS
  - Continue to build on AP203/AP209, adding capabilities through modules





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# ***AP209/EACM Architectural Issue Summary***

- **Number one STEP/GEM/EACM integration issue is how to accommodate the GEM/EACM architecture within the context of the existing STEP modular architecture**
  - **This will mean significant change to the root of the GEM/EACM**
- **The mathematical representation schema required to represent varying fields is currently not enjoying wide support**
- **Property and specification need a closer look to see how they will be integrated with core STEP modules**
- **GEM/EACM brings many new capabilities to the table**





## ***Starting Point for EA Extensions***

- **Integration with STEP/TAS thermal analysis work**
- **Non-manifold geometry to support meshing**
- **Mathematical varying field representations**
- **Structured grids (commonly used in CFD, heat transfer)**
- **Property assignment**
- **Time varying states**
- **Nonlinear analysis extensions (material, geometric)**
- **Multi-physics analysis integrations (Basic GEM/EACM goal)**
- **Mesh independent analysis (Basic GEM/EACM goal)**